

## O 66: Nanostructures at surfaces III

Time: Thursday 10:30–13:00

Location: MA 042

O 66.1 Thu 10:30 MA 042

**Conductance measurements of single graphene nanoribbons with scanning tunnelling microscopy** — ●MATTHIAS KOCH<sup>1</sup>, FRANCISCO AMPLE<sup>2</sup>, CHRISTIAN JOACHIM<sup>2,3</sup>, and LEONHARD GRILL<sup>1</sup> — <sup>1</sup>Dept. of Physical Chemistry, Fritz-Haber-Institute of the Max-Planck-Society, Berlin, Germany — <sup>2</sup>Institute of Materials Research and Engineering (IMRE), Singapore — <sup>3</sup>Nanosciences Group, CEMES-CNRS, Toulouse, France

Graphene nanoribbons (GNR) are promising candidates for molecular wires in future nanotechnology. Their planar atomic structure leads to electronic properties that strongly depend on their edge-structure and width. We have assembled such GNRs in a bottom-up approach directly on a metal surface and characterized them by low temperature scanning tunneling microscopy (LT-STM). Such a process leads to atomically defined edges, which are required for charge transport studies as structural defects have been predicted to modify the electronic structure and to reduce the conductance. After their characterization by STM, we have performed conductance measurements of single GNRs by pulling them off the surface with the STM tip. In this way, single molecules are contacted to two electrodes in a controlled way and can at the same be characterized before and after such a procedure at the atomic level. Importantly, the electrode-electrode distance is varied during the measurements, thus allowing length-dependent conductance measurements, which are necessary for a fundamental understanding of charge transport. We find that the conductance exponentially decreases with the molecular length in the junction.

O 66.2 Thu 10:45 MA 042

**Measuring the one-dimensional band structure of an armchair graphene nanoribbon** — ●CHRISTOPHER BRONNER<sup>1</sup>, FELIX LEYSSNER<sup>1</sup>, STEPHAN MEYER<sup>1</sup>, MANUEL UTECHT<sup>2</sup>, PETER SAALFRANK<sup>2</sup>, TILLMANN KLAMROTH<sup>2</sup>, and PETRA TEGEDER<sup>1</sup> — <sup>1</sup>Freie Universität Berlin, Fachbereich Physik, Arnimallee 14, 14195 Berlin, Germany — <sup>2</sup>Universität Potsdam, Institut für Chemie, Karl-Liebknecht-Straße 24-25, 14476 Potsdam, Germany

Besides other low-dimensional carbon materials, graphene nanoribbons (GNRs) have attracted great interest in the past years. These flat, quasi-one-dimensional structures which can be thought of as stripes cut out of graphene, offer a wide range of band structures depending e.g. on their width, edge shape and applied electric fields, which makes them interesting for nanotechnology applications. Despite the intriguing properties predicted by theory, relatively few experiments have been conducted on GNRs because the fabrication of well-defined, narrow ribbons is challenging. Recently, surface-assisted bottom-up fabrication has been employed on the Au(111) surface to produce a defect-free GNR [1]. We employed complementary surface-sensitive spectroscopies and supporting DFT calculations to determine the electronic structure of those particular GNRs, especially the band gap and dispersion. [1] J. Cai et al., Nature 466, 470-473 (2010)

O 66.3 Thu 11:00 MA 042

**Characterization of nano-scale electrical contacts using dynamical Coulomb blockade** — CHRISTOPHE BRUN<sup>1</sup>, ●KONRAD H. MÜLLER<sup>2</sup>, I-PO HONG<sup>1</sup>, FRANÇOIS PATTHEY<sup>1</sup>, CHRISTIAN FLINDT<sup>2</sup>, and WOLF-DIETER SCHNEIDER<sup>1</sup> — <sup>1</sup>Institut de Physique de la Matière Condensée, Ecole Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland — <sup>2</sup>Département de Physique Théorique, Université de Genève, CH-1211 Genève, Switzerland

The theory of dynamical Coulomb blockade (DCB) has in the past been successful in describing transport measurements in carefully engineered tunnel junctions by explicitly taking into account the electrical circuits in which they are embedded [1,2]. Here we use the theory of DCB to explain recent scanning tunneling spectroscopy measurements on flat metallic nano-scale islands electrically coupled to their supporting substrates [3]. The observed suppression of the differential tunnel conductance at small bias voltages is due to DCB and can be understood by considering the island-substrate contact as an Ohmic resistor in parallel with a plate capacitor. Our theoretical calculations are in good agreement with the measurements and allow us to investigate the systematic dependence of the resistances and capacitances on the island-substrate contact area.

[1] M. H. Devoret *et al.*, Phys. Rev. Lett. 64, 1824 (1990).

[2] G.-L. Ingold and Yu. V. Nazarov, in *Single Charge Tunneling* (Plenum, New York, 1992).

[3] C. Brun, K. H. Müller, I-P. Hong, F. Patthey, C. Flindt, and W.-D. Schneider, in preparation (2011).

O 66.4 Thu 11:15 MA 042

**Characterization of Different Growth Regimes on Prepatterned Surfaces** — FABIAN LIED<sup>1</sup>, ●TANJA MUES<sup>1</sup>, WENCHONG WANG<sup>2</sup>, LIFENG CHI<sup>2</sup>, and ANDREAS HEUER<sup>1</sup> — <sup>1</sup>Institut für Physikalische Chemie, Westfälische Wilhelms-Universität Münster — <sup>2</sup>Physikalisches Institut, Westfälische Wilhelms-Universität Münster

Molecule deposition on a prepatterned substrate is a recently developed technique to generate structures of organic molecules on surfaces via self-organization. For the case of prepatterned stripes the time-resolved process of structure formation is studied via Lattice Monte Carlo simulations. By systematic variation of the interaction strength three distinct growth regimes can be identified: localized growth, bulge formation and cluster formation. All three growth regimes can be recovered in the experiment when choosing appropriate organic molecules. Some key microscopic observables, reflecting the properties of the structure formation, display a non-monotonous dependence on the interaction strength.

O 66.5 Thu 11:30 MA 042

**Pt(111) supported monolayer graphene as template for Pt nanoparticle formation.** — NADJA E. WAGNER, ●ALBERT K. ENGSTFELD, and R. JÜRGEN BEHM — Ulm University, Institute of Surface Chemistry and Catalysis, D-89069 Ulm, Germany

Recent investigations have shown that graphene monolayer films deposited on metal single crystal surfaces can be used as templates for the nucleation of periodic arrays of metal nanoparticles. These surfaces are promising model systems to study the electrocatalytic properties of very small metal nanoparticles. For the electrochemical measurements it is crucial that the graphene layer is perfectly closed to prevent electrooxidation and exposition of the substrate. It has been shown that graphene on Pt(111) can be grown, [1] the requirement of a closed layer, however, could not yet be fulfilled.

In this work the graphene layer was prepared by ethene exposure at elevated temperatures and different pressures in UHV. The properties of graphene monolayers on Pt(111) were studied by high resolution STM. We will show that it is possible to form a compact graphene layer on Pt(111) under these conditions. The ethylene pressure was found to play an important role on the homogeneity of the graphene layer. With increasing ethylene pressure the amount of domain boundaries rises due to an increasing number of smaller rotational domains. The homogeneity of the surface is checked by electrochemical measurements. Evaporation of Pt on gr/Pt(111) was investigated, and results will be presented.

[1] T. A. Land et al., Surface Science. 264, 1992, 261-270

O 66.6 Thu 11:45 MA 042

**Anisotropic behavior of organic molecules on prepatterned surfaces** — ●STEFAN FRIEDER HOPP and ANDREAS HEUER — Institut für Physikalische Chemie, Universität Münster, 48149 Münster, Germany

The nucleation of organic molecules on surfaces, prepatterned with gold stripes, is investigated with emphasis on anisotropy effects. Representing the molecules as ellipsoids, the related particle-particle interaction is modeled by means of a generalized Gay-Berne potential for similar biaxial particles [1]. The orientational behavior of these ellipsoidal molecules with respect to the stripe pattern is studied for the first monolayer by performing kinetic Monte Carlo simulations. It is shown how the properties of the particle alignment depend on energy scales, temperature and flux. Based on the fact the particles strictly arrange in rows, it is furthermore instructive to analyze the orientation behavior within the different rows. Finally, the transfer of orientation from a preset row of molecules with fixed orientation to other nucleating particles is examined.

[1] R. Berardi, C. Fava and C. Zannoni, Chem. Phys. Lett. 236, 462 (1995).

O 66.7 Thu 12:00 MA 042

**Scanning tunneling microscopy study of antimony clusters on Si(111)7x7** — ●STEPHAN APPELFELLER, MARTIN FRANZ, and MARIO DÄHNE — Institut für Festkörperphysik, Technische Universität Berlin, Hardenbergstr. 36, D-10623 Berlin

The growth regime of surface clusters is located between single atom adsorption processes and long range surface reconstructions. These surface clusters are interesting structures to analyze not only because of their possible use in nanocatalysis and the miniaturization of nanodevices but also for their unique physical properties. Here, clusters were grown on heated, 7x7 reconstructed Si(111) substrates by molecular beam epitaxy with submonolayer antimony coverages. Several different cluster appearances were found depending on the exact preparation conditions using a scanning tunneling microscope. The structural and electronic properties of the dominant cluster types were studied with a focus on antimony clusters which appear ring like in empty state images. These ring clusters form preferentially at an edge of a faulted half unit cell and represent up to 75% of all clusters observed in the measurements. A structure model that explains the experimental results well was developed for these ring clusters. This work was supported by the DFG through FOR 1282 project D.

O 66.8 Thu 12:15 MA 042

**Separation of length scales to estimate the elastic energy of a heteroepitaxially deposited crystal** — ●GUILLAUME BOUSSINOT — MPIE, Duesseldorf, Germany — PGI, Forschungszentrum Juelich, Germany

In heteroepitaxy problems, the elastic energy of the system is in general a very non-trivial function of the shape of the deposited crystal. We use the separation of length scales describing this shape to estimate the elastic energy of a cylindrical crystal and find its equilibrium dimensions for a given volume.

O 66.9 Thu 12:30 MA 042

**Diamond-Like Carbon Coatings on Selected Plastic Materials** — ●CHRISTIAN B. FISCHER<sup>1</sup>, MAGDALENA ROHRBECK<sup>1</sup>, STEFAN WEHNER<sup>1</sup>, MATTHIAS RICHTER<sup>2</sup>, and DIETER SCHMEISSER<sup>2</sup> — <sup>1</sup>Universität Koblenz-Landau, IFIN - Physik, 56070 Koblenz, Germany — <sup>2</sup>BTU Cottbus, Angewandte Physik II / Sensorik, 03046 Cottbus, Germany

The manufacturing of synthetic materials and their wide range of use for daily life is accompanied by essential requirements. Besides the basic performance of materials such as flexibility, elasticity, fracture strength and chemical resistance, further determinants are long term stability or biocompatibility. To overcome mismatches in surface characteristics of optimal parent material they can be customized for their intended use resulting in suitable coatings for profitable applications. The determining factor for such modifications is the preservation of basic material performance in addition to the benefit of further advantages like changed adhesive, improved repellent or antibacterial behavior. Protective coatings of selected plastic materials have been realized by depositing a few layers of diamond-like carbon (DLC). The assembly of soft plastic material and robust DLC coating is important for the resulting material characteristics. The detailed understanding of materials interphasing between these unequal materials and the conjunction of carbon centers in chemically different neighborhood is part of the presented work. Results will be transferable to other plastic materials with diverse needs, e.g. energy storage devices, water treatments and coatings for everyday commodities or industrial parts.

O 66.10 Thu 12:45 MA 042

**Continuum modeling of particle redeposition during ion-beam erosion** — ●CHRISTIAN DIDDENS and STEFAN J. LINZ — Institut für Theoretische Physik, Universität Münster, Wilhelm-Klemm-Straße 9, 48149 Münster, Germany

We have studied the redeposition mechanism during ion-beam erosion and its impact on the formation of nanopatterns within a suitable continuum model [1]. Since particle redeposition is a complex and highly non-local process, one is interested in an approximation which holds for generic surface morphologies. The detailed analysis of this model reveals, that the redeposition yield can be approximated by a Taylor expansion around the surface mean height, as it has already been shown in a discrete solid-on-solid model [2]. In addition, by combining a common erosion model (Kuramoto-Sivashinsky equation) with the presented redeposition model, we show, that redeposition of eroded particles is able to trigger the emergence of long-range ordered nanopatterns.

[1] C. Diddens, S. J. Linz, unpublished

[2] N. Anspach, S. J. Linz, J. Stat. Mech., P06023 (2010)